UTGARD Laboratory

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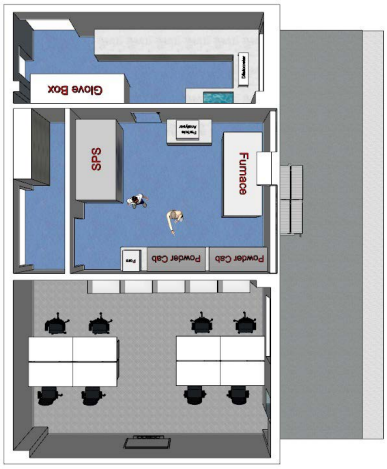
Mission: To establish a university facility for simulated spent nuclear fuel (SIMFUEL) fabrication and characterisation that is unique within the UK higher education landscape, in order to drive and accelerate UK spent nuclear fuel research.

A postdoctoral researcher prepares a radioactive liquid sample for analysis



Design sketch of UTGARD Phase II Laboratory space attached to the existing UTGARD

A uranium dioxide pellet electrode prepared in UTGARD Laboratory

Research Themes

UTGARD Phase II will focus on oxide SIMFUELs, including MOX and ThO_2-based fuels. The new facility will extend Lancaster's existing radiochemical lab for open sources, UTGARD, enabling research in the following themes:

1) **Development of new, advanced sintering routes for the fabrication of SIMFUELs** with porosities, fission product loadings, and defect microstructures that better simulate those of real spent nuclear fuel (UTGARD Phase II).

2) **Behavioural studies** of advanced SIMFUELs, as well as those prepared using conventional techniques, under a range of conditions relevant to the back end of the fuel cycle – including wet/dry interim storage, geological disposal and new reprocessing routes (UTGARD Phase I).

Facilities

Constructed in 2016, UTGARD Laboratory is a ~120 m^2 process chemistry laboratory for work on β/γ active fission products, uranium, thorium and low level alpha tracers.

UTGARD Phase II involves an extension to the existing UTGARD Laboratory, generating a further ~40 m^2 of new laboratory space. As with the existing laboratory, UTGARD Phase II will be rated to the highest level of university open source radiation protection, allowing for the handling of a wide variety of radioactive isotopes for use in SIMFUEL manufacture.

Equipment

UTGARD Phase II

SIMFUEL powder precursor preparation:

- Licence for the FISPIN fuel depletion code, for calculation of target SIMFUEL compositions as functions of burnup and cooling time.
- Planetary ball mill (Retsch) and particle sizer (Horiba) for control and measurement of the size of SIMFUEL precursor powders

Sintering of SIMFUEL precursors into pellet form:

- Up to 100% hydrogen tube furnace (Nabertherm) for conventional sintering of green pellets prepared using existing powder presses.
- SPS system for advanced binder-free field assisted rapid sintering studies.
- Modified dilatometer (Netzsch), for monitoring pellet densification during sintering and for the study of the novel route of flash sintering.

Post-sintering sample preparation and characterisation:

- Mercury porosimeter (Anton-Paar) to assess pellet porosity post-sintering.
- Powder cabinet-isolated diamond saw and grinding and polishing machine (Struers) for sample preparation.

UTGARD Phase I

Radiation handling and measurement

- α/β counter and multi-sample gamma counter/spectrometer
- HEPA filtered negative pressure and anoxic positive pressure gloveboxes
- Two banks of two centrifugal contactors

Electrochemistry

- Multiple potentiostats, rotating disk electrodes and quartz crystal microbalances

Spectroscopy

- Raman microscope (with hot stage), ATR FT-IR and UV-VIS-NIR (with stop-flow adaptor).

Chromatography

- HPLC and Anion/Cation Ion Chromatography system with combined Mass Spectrometer (IC-MS)

Thermal Analysis

- TGA/DSC system with combined gas mass spectrometer (TGA-MS)

Elemental characterisation/imaging

- SEM with EDX, Large chamber XRF system

Contact details

Please contact Dr Richard Wilbraham via email at **r.wilbraham@lancaster.ac.uk** or telephone on +44 (0)1524 594866 to discuss your potential project.

Availability

UTGARD is currently scheduled to be available for access by external users from January 2021, depending on social distancing measures on the Lancaster University campus. Up-to-date information about availability, in light of the COVID situation, is available at **https://www.nnuf.ac.uk/utgard-laboratory**.